



U.S. Department of Commerce
National Oceanic and Atmospheric Administration

For more information:

Assistant Administrator, Office of Oceanic and Atmospheric Research

National Oceanic and Atmospheric Administration

SSMC-3, #11627

1315 East-West Highway

Silver Spring, Maryland 20910

1 (800) 944-0203

<http://www.oar.noaa.gov>

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UNDERSTANDING THREATS

*From the Bottom of the Ocean to the Surface of the Sun
to Society and the Environment*



A Strategic Plan for NOAA Research

A MESSAGE

from the Assistant Administrator

NOAA Research has a history of success, and a critical role for the future. Integral to both is the outstanding team of scientists and others that serve NOAA's mission to provide unbiased scientific knowledge about our environment. NOAA is charged with both forecasting the state of the environment, as well as protecting, regulating, and managing our vast living marine resources. Necessary to providing these services is an independent third component: a broad research foundation for understanding the systems that support our planet.

The achievements of NOAA Research are rich and varied. For weather services, we have developed tools such as the NEXRAD radar, models, and new systems technology that have made five-day weather forecasts as accurate as three-day forecasts once were. For fisheries resources, we have characterized the habitat essential for fish to reproduce and thrive. And for understanding, we have begun to explain the physics governing climate that has made the once elusive phenomenon El Niño predictable months in advance. We have also sustained long-term ozone measurements over the Antarctic and have used them to describe the chemistry of the ozone hole and inform international policymakers. More recently, major biotechnological advances in the development of cancer-fighting drugs are within reach because of new capabilities in undersea technology that allow us to explore our ocean's exotic resources. Each of these breakthroughs brings enormous benefits to society, and all had their genesis years ago in NOAA Research.

Today, NOAA scientists continue to be world-renowned researchers and leaders in understanding earth systems. Long-term monitoring, assessments, directed research, and extension are our essential tools for learning more about our planet's growing suite of environmental challenges and communicating those results.

*From
the
bottom
of the
ocean . . .*



*. . . to the
surface of
the sun*

However, our path to sustaining these activities must be clear. First, if NOAA is to continue to fulfill the role of honest broker of scientific knowledge, it must keep its research activities free from the demands of day-to-day operations and the pressures of regulation. Without this separation, research will wither and, with it, the future of NOAA and our ability to provide superior science. Second, there must be research direction and links to partners who can deliver the benefits of our results. In preparing this Strategic Plan we took steps to reconnect with our NOAA partners, and to recognize the growing role of universities and the private sector in providing environmental services. Along the way, we were reminded that keeping our partners and customers involved in developing the research agenda will increase its ultimate utility.

I am committed to making NOAA Research a strong partner in answering the increasingly complex questions concerning our environment. This Plan will guide us for the next several years, and each year we will set priorities in concert with NOAA's Strategic Plan and the needs of those we serve. At the end of this decade, we will again recall the advances made toward addressing the environmental challenges we now face. I invite you to read about these challenges, and our vision for the role NOAA Research will play in responding to them.

David L. Evans

Assistant Administrator for Oceanic and Atmospheric Research



OUR DYNAMIC PLANET *and the Role of NOAA Research*

Our planet's natural systems operate in a mode of nearly constant change. As we enter a new century, humans are increasingly affecting and being affected by those systems. A growing world population, rising demand for food and clean water, greater human exposure to natural hazards, changing climate patterns, and other environmental factors present enormous chal-

lenges to societies around the world. In the United States, migration to the coasts and the sprawling growth of our urban areas are shifting the location of human impact. And while technology's global reach is leaving some nations struggling to balance the information age with information overload, others worry that the effects of technology have actually led to unforeseen environmental

Society increasingly relies upon accurate weather and climate information to diminish the harsh impacts of droughts, flooding, and other environmental threats. NOAA Research is committed to building services that help citizens respond to these threats, as well as examining these phenomena for potential opportunities in key areas, such as agriculture and natural resource management.



consequences, such as climate change and vulnerability to food supply disruptions.

Fortunately, we continue to learn more about the complex interactions among our planet's air, water, solar, and land systems. Each year we better understand the ocean's role in controlling climate patterns, and the role of changing climate on weather phenomena. We also recognize the role humans play in all of these interactions. In every sector of society the need for unbiased scientific information to support a multitude of decisions about environmental threats has never been more critical. This scientific foundation must account for the complexity inherent in natural systems, but must also clearly convey information and uncertainty to decision-makers and the public.

Our nation's insurance against threats to our economy and environment is research relevant at the human scale, improved predictions of environmental phenomena, and continued explorations of poorly understood systems. The table on the following page and the actions in this Strategic Plan illustrate how NOAA Research is positioned to define these scientific challenges over the next decade. We are committed to providing the best available information and products to help decision-makers address them both locally and globally.

This scientific support ranges from theoretical studies to long-term monitoring to practical operations—spanning regions from the bottom of the ocean to the surface of the sun. These products and information emerge from our ability to gain knowledge and understanding about the environment, and to use it to improve capabilities for predicting and managing earth processes and systems. Decision makers in all parts of our society rely on our products and information

MISSION & VISION *of NOAA Research*

NOAA Research strives to balance its near-term responsibility to address the needs of its primary customers both inside and outside of NOAA with its longer-term commitment to conduct visionary research that will be critical for managing future environmental and societal threats. This dual responsibility requires us to perform research that leads to the transfer of information and new technologies, as well as to explore the unknown and develop important new concepts.

VISION

A society that uses the results of our research as the scientific basis for more productive and harmonious relationships between humans and their environment.

MISSION

To conduct research, develop products, and provide scientific information and leadership toward fostering NOAA's evolving environmental and economic mission.

to make more effective judgments in areas as diverse as agriculture and natural disaster response.

The four components of NOAA Research that provide these products and services are: 12 federal laboratories and their Joint Institute partners, the National Sea Grant College Program, the Office of Global Programs, and the National Undersea Research Program. Our customers and research partners include other parts of NOAA, federal agencies, international entities, state and local governments, universities, and private industry. The Department of Commerce provides policy guidance and resources we need to accomplish our goals.

This Strategic Plan establishes the foundation of NOAA Research as a leader in providing unbiased information in earth sciences to our nation. It will form the basis of our research agenda that seeks to better understand threats to our nation's health, safety, and prosperity.

Economic, Environmental, and Societal Threats

Human Safety

Losses to our inland communities because of tornadoes, flooding, and winter storms; to our coastal communities because of hurricanes and marine weather; and to our nation because of solar events and hazardous air quality all point to the critical need for enhanced predictive capabilities.

Tremendous potential exists for better prediction of our variable and changing climate. Such improvement can save lives and billions of dollars as we endure flooding, heat stress, drought, significant changes in sea level, and potentially increased hurricane intensity, in areas where human impact is high.

Environments and communities that rely on healthy coasts to thrive and support recreation, drinking water, and seafood production face continual threats associated with contaminated water, hypoxia, harmful algal blooms, coastal erosion, and marine accidents. Other hazards, such as tsunamis and severe conditions for navigation, pose near-term threats that reinforce the need for monitoring and prediction along our coastlines.

Economic Security

Increasing demand for agricultural products and variable supplies of seafood require us to find other ways of cultivating a sustainable food supply. Some examples include improving climate forecasts for better crop planning and promoting more sustainable approaches to aquaculture.

Responsibility for environmental protection is scattered over an array of government agencies, making comprehensive planning a challenge for land use, water resource management, irrigation and pesticide use, fisheries management, and overall ecosystem health. Decisions in many of these areas must be made on the basis of integrated scientific information.

Human and Environmental Health

Increasing cases of heat stress and respiratory illness, as well as health problems associated with elevated ultraviolet radiation, airborne and waterborne pollution, and vector-borne disease, force millions of Americans to undergo expensive medical procedures. Without an improved ability to forecast the climatic, aquatic, and air quality conditions under which these threats to human health thrive, their impacts will rise.

Our natural systems are being pushed to their limits. Poor air and water quality, habitat loss, invasive species, and nutrient overload are some of the many environmental and economic concerns affecting regions across the nation. Sustained studies of air basins, watersheds, and water bodies that cross state and local boundaries are needed to effectively manage these threats.

National Security

Increasing environmental threats, such as climate change, poor air quality, and generally degraded ecosystems, are causing security crises in many places around the world. Rising numbers of displaced persons and immigration aggravate already strained environmental and political systems. An improved capability to forecast climate would vastly strengthen governments' abilities to mitigate events that cause these short-term security problems.

Military concerns rely on accurate weather prediction and mapping of our coastlines to protect our nation against security threats. Information about the potentially negative effects of space weather on operations is critically important as activity levels in space have grown.

NOAA Research Goals

Improve the reliability, accuracy, timeliness, and specificity of detection and prediction of hazardous and disruptive weather to help society cope with these phenomena.

Better characterize the human and natural influences on climate, and assess risks on regional and global scales to help society cope with potential impacts.

Better characterize, detect, and predict factors that threaten water quality, navigation capabilities, and coastal communities.

Convert potential threats into opportunities by creating innovative tools, technologies, and applications for societal and economic gains.

Enhance scientific information to promote effective national, state, and local environmental and economic decision-making.

Enhance the identification, characterization, and prediction of environmental threats to human health.

Enhance the identification, characterization, and prediction of environmental threats to ecosystem health.

Foresee and characterize the environmental changes that lead to global security issues.

Enhance and improve atmospheric, oceanic, and space information in support of military and other national security operations.

UNDERSTANDING *to Society* THREATS *and the Environment*

NOAA Research

is committed to

providing the nation

with the knowledge

and tools needed

to minimize threats

to our safety,

economy, security,

and to human and

environmental health.

SCIENCE

Deliver a new generation of environmental prediction and management capabilities that will reduce exposure to phenomena that threaten safety, economy, human and environmental health, and security.

NOAA Research proposes, in conjunction with the NOAA Strategic Plan and our many partners, clear strategies for providing predictive and environmental management services. We offer three integrated strategies in the areas of climate, oceans and coasts, and weather that will assist NOAA in reducing exposure to a variety of threats. These strategies will help advance our understanding of whole systems and will link these areas of research to local, regional, and global scales. NOAA Research will employ state-of-the-art exploration tools, observations, models, synthesis, and communications systems to maximize knowledge gained.

Biotechnological research conducted by NOAA Research scientists has revealed candidates for new drugs and treatments from the sea that can be used in the fight against a wide range of human ailments, including cancer and AIDS. Advances such as these originate from NOAA's unique ability to explore our oceans through the use of underwater technologies like the deep-sea sub *Alvin*.

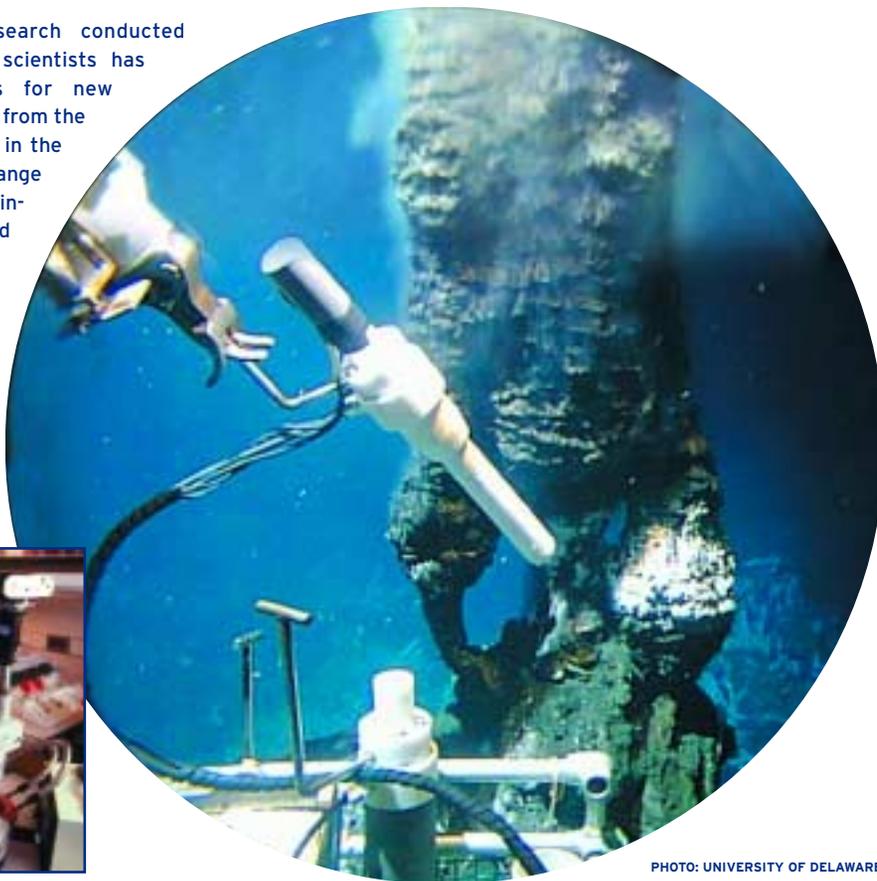


PHOTO: UNIVERSITY OF DELAWARE

STRATEGY *Create new climate products and services.*

The sharp rise in demand for climate information as input to decision-making drives our research agenda to improve knowledge of the mechanisms that control our climate. For example, producing drought warnings 3–6 months in advance will mitigate agricultural and economic impacts, as well as allow for better water resource management. These forecasts will also be used to combat disease propagation linked to higher average temperatures. The possibilities for using climate forecasts are nearly endless, but extensive research is still needed to fully realize them.

ACTIONS **MEET** increasing national demands for integrated climate information products and services by converting advances in research to practical applications.

BETTER characterize and understand the role of the oceans in weather and climate predictions.

PROVIDE comprehensive, long-term monitoring of greenhouse gases and information about their characteristics to assist in decision-making.

STRATEGY *Build coastal and ocean prediction, exploration, and management tools.*

Our long-term coastal and ocean research planning reflects scientific issues associated with the growing numbers of communities settling along our oceans and Great Lakes and increased commerce being conducted on our waterways, as well as the opportunities yet to be discovered in our vast oceans. This information can be directly used to better manage problems, such as variable seafood production, harmful algal blooms, weakened ecosystems associated with invasive species, and human health ailments whose cures may lie in hydrothermal systems beneath the ocean floor.

ACTIONS **BUILD** NOAA predictive capabilities that improve safety and contribute to both ecosystem health and the economy for all coastal environments.

DEVELOP new tools and methods for environmental assessment and prediction.

DEVELOP and provide the essential understanding of the physical, chemical, and biological aspects of the oceans and Great Lakes as vast storehouses of living marine resources, in support of comprehensive ecosystem management.

EXPLORE and observe deep-ocean areas beyond the coasts, to identify new resources and environments of special value.

STRATEGY *Enhance atmospheric products and services.*

Our atmospheric research agenda spans from the quality of the air we breathe, to the physics, chemistry, and dynamics of our atmosphere's processes, to the sun's impact on the earth. Improved forecasts, warnings, and use of information in decision-making reduces our exposure to immediate threats, such as hurricanes, tornadoes, poor air quality, and other types of hazardous environments—saving lives and potentially billions in property.

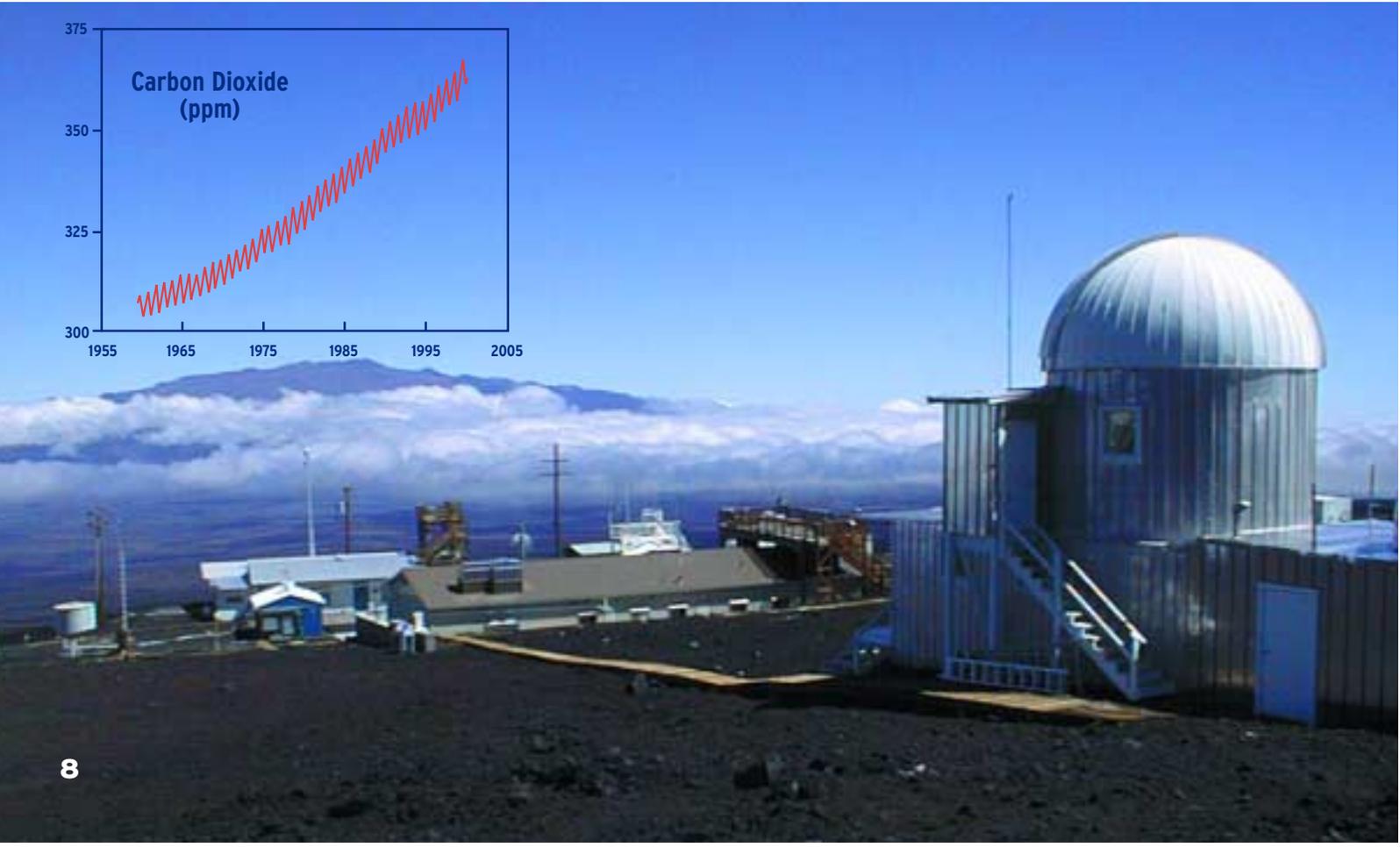
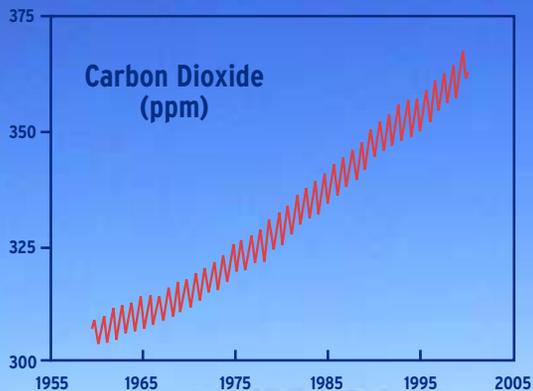
ACTIONS

DESIGN, develop, and integrate mesoscale weather-observing systems and models to provide improved short-term, location-specific forecasts.

PROVIDE the scientific foundation for a national air quality predictive system, focusing on regional populations and sensitive ecosystems.

DEVELOP the knowledge needed to predict solar events that could disrupt our nation's communication and energy infrastructure, and support this capability as an operational service.

The increase in global atmospheric carbon dioxide over the last 40 years has been continuously recorded at Mauna Loa, HI, one of four stations that make up the NOAA Research global air sampling network. Since the late 1950s, these concentration levels have risen by at least 50 parts per million. The potential effects of this increase on the earth's atmosphere have been modeled by NOAA Research scientists who are providing the world with a foundation of critical knowledge about this trend and its impacts on society.



PARTNERSHIPS

Create alliances that effectively address strategic environmental issues and challenges.

NOAA Research needs partnerships to carry out its mission. Limited resources and complex problems make partnerships essential to the overall portfolio of research-driven advances. Ultimately, research that is sustained will have a clear path to NOAA service organizations and our customers.

STRATEGY *Increase collaborations with customers and partners in research.*

ACTIONS **EXPAND** integrated planning, budgeting, and program development across NOAA line organizations that recognizes NOAA Research as a critical source of scientific information for the agency and its environmental services.

IMPROVE partnerships with other federal agencies in planning and implementing an integrated environmental service that provides forecasts from air quality to climate.

STRENGTHEN collaboration with universities on research activities, and recognize the expanding role of academia in providing services.

ASSIST industries focused on reducing threats to society and the environment, and expand cooperative research efforts with the private sector to improve observations, models, and services.

DEVELOP and nurture state and local relationships in support of a regional research agenda for NOAA that addresses location-specific environmental issues and challenges.

CREATE new mechanisms to engage the international community in cooperative research and assessments focused on global-scale environmental issues.

BUILD on existing Sea Grant Extension Networks as an avenue for customers to voice their needs.

Bycatch of protected species is a serious national concern. The National Academy of Sciences estimates that in the 1980s, southeastern shrimp trawling may have resulted in up to 55,000 sea turtle drownings every year. The required use of turtle excluder devices, developed by NOAA's National Sea Grant Program in concert with the National Marine Fisheries Service, has reduced this mortality rate significantly.



ORGANIZATION

Increase the long-term commitment to research with recruitment of superb scientific talent, increased funding, streamlined processes, and modernized systems.

The foundation of NOAA Research is its people and supporting systems. Continued commitment to attracting and retaining high-quality employees and maintaining adequate infrastructure is critical, in addition to preparing for the long-term needs of the organization. Incentives to creatively build capacity will enhance the organization's ultimate ability to carry out its mission.

STRATEGY *Shape a strong workforce.*

NOAA Research must maintain the highest scientific expertise and administrative capability in its people. Steps must be taken to ensure that quality of work life is high and the professional opportunities great. In addition, our aging federal work force will call for creativity in filling critical leadership gaps.

ACTIONS

USE creative outreach methods to attract strong employee candidates.

ENCOURAGE diversity as a way to attract the best and brightest employees.

LEVERAGE the new performance appraisal system to reward high achievers, while encouraging others to strengthen their capabilities and contributions.

EXPLORE sabbatical and/or exchange programs as a means of bringing fresh ideas to bear on policy and management challenges.

STRATEGY *Promote financial health.*

Research enterprises fulfill a unique role in organizations, and they must be financially protected from operational demands.

NOAA Research staff, some of whom are shown here on the NOAA Research vessel *Ronald H. Brown*, combine unparalleled expertise with a true commitment to understanding our planet's natural systems. Investments in our human resources today will pay off now and in the future with a stronger and more diverse workforce.



ACTIONS

RESTORE financial integrity to environmental research by obtaining funding for new initiatives, and by negotiating inflation adjustments and funding for mandated pay raises.

RAISE the nation's awareness of the dangers associated with reduced environmental research capability.

STRATEGY *Transfer technology.*

Limited resources call for the efficient transfer of technologies and information into operations. The solution lies in greater working relationships with the myriad NOAA Research partners.

ACTIONS

WORK with our partners to establish mutual understanding, support, and shared responsibility for transfer of research results to operations.

WORK with other NOAA line organizations to create explicit inter-line office funding mechanisms to ensure transition of research results into operations.

WORK with other NOAA line organizations to define an overall systems architecture that can identify both weaknesses and new opportunities for transfer of research results to operations.

STRATEGY *Build infrastructure capacity.*

Sound infrastructure for research is second only to a skilled workforce. As environmental challenges grow, so too will our need to maintain and propose new capacity to measure, model, and monitor earth systems.

ACTIONS

MAINTAIN state-of-the-art platforms, research instrumentation, and facilities to support all research activities.

CREATE new platforms and instruments to enhance observational research and development.

Over the last 30 years, NOAA Research has provided the scientific and technological foundation for the largest modernization effort in the history of the National Weather Service. The development of a national network of NEXRAD Doppler radars and the completion of an advanced weather prediction system comprise much of this effort. Supporting and complimenting these tools are the platforms, such as aircraft and ocean buoys, that capture additional data critical to weather forecasting.



EDUCATION

Foster the public's ability to understand and integrate scientific information into considerations of national environmental issues.

Society must better understand the threats facing our economy and environment, and the role science can play in responding to them. NOAA Research proposes to expand the public's exposure to research results through several outlets.

STRATEGY *Engage the public in science learning and problem-solving.*

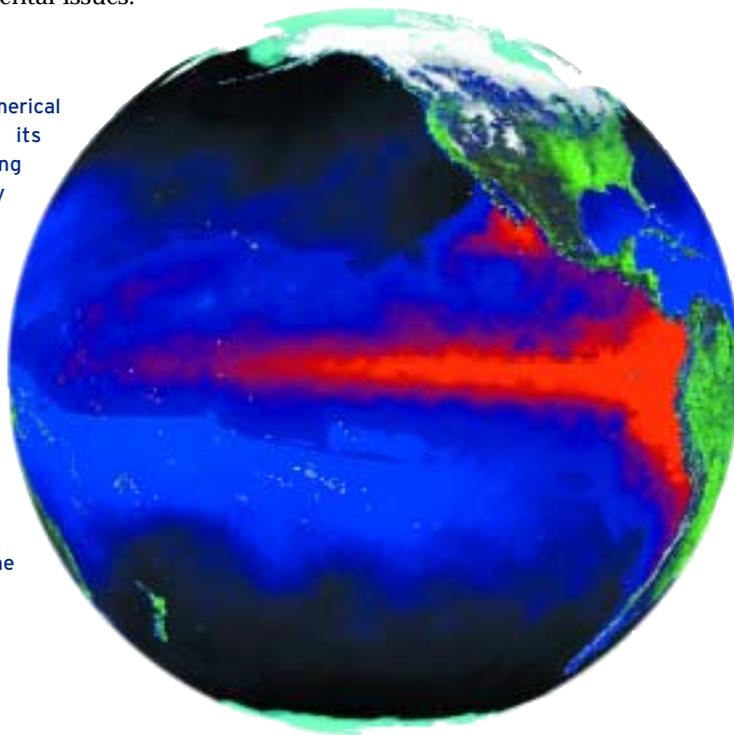
ACTIONS **COMMUNICATE** NOAA Research results on important national and international issues to society, using multiple media outlets that span from the popular press to professional scientific journals.

ENCOURAGE new and diverse scientific talent by supporting programs for grades K-12, and for undergraduate and graduate students.

ENSURE that NOAA Research successes are publicized rapidly and widely, through Sea Grant Extension and other means.

POSITION NOAA Research as the source for answers and expertise on environmental issues.

Using a combination of numerical modeling and data from its tropical Pacific observing system, NOAA successfully predicted and monitored the largest El Niño event on record in 1997-98. Predictions such as these originated in the coupled (ocean-atmosphere) global climate models developed by NOAA Research scientists, recognized as world leaders in modeling the complex physical processes that govern the behavior of the atmosphere and oceans.



A LONG-TERM *to World-Class Research* COMMITMENT

Key to the success of NOAA is a long-term commitment to its research and the many talented and dedicated people who work daily to solve mysteries of our earth's systems. NOAA Research partnerships with academia, with other federal institutions, and with the private sector are also critical components in an overall strategy to provide our nation's leaders with the knowledge they need to make informed decisions. We have a dual responsibility to address urgent current issues through the creative transfer of new concepts to practical use, and to explore the facets and trends of our environment that will influence our future. Through a renewed commitment to research, our human talent, and strengthened relationships with our partners, NOAA Research will continue to provide the nation with the scientific information it requires to thrive in a changing world.